INTERVAL

Formal Design, Validation and Testing of Real-Time Telecommunications Systems

IST-1999-11557

Title : Technology Implementation Plan

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Abstract : This deliverable constitutes the final version of the Intermediate Technology Implementation Plan which is to be officially delivered at month 12 of the project. This version provides a description of the main project results and the main plans for their utilisation by the INTERVAL partners after the project end.

Additionally, it provides information on the dissemination activities undertaken by the partners to promote the wider adoption of the INTERVAL results. Quantitative data as well as intentions to use third parties for the further INTERVAL exploitation are not contained in this preliminary version.

ITM LÜBECK (D), TELELOGIC (F), SOLINET (D), ERICSSON (S),
FRANCE TELECOM R&D (F), TELETEL (EL).

History

Date	Version	Comments
16 November 2000	1	First draft
12 December 2000	2	SOLINET contribution
14 December 2000	3	ERICSSON contribution
20 December 2000	4	TELELOGIC contribution
21 December 2000	5	TELETEL, FRANCE TELECOM, ITM contributions
22 December 2000	6	VERIMAG contribution & Pre-Final version
27 December 2000	7	Pre-Final Document delivered to the CEC
04 April 2001	8	Final Document

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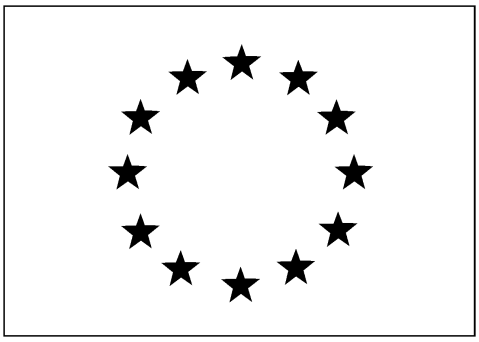
TECHNOLOGICAL IMPLEMENTATION PLAN

A Framework for the further development, dissemination and use of the results of EC RTD Projects (including also thematic networks and concerted actions)

DATA SHEETS



☒ Preliminary version at mid-term (optional, programme per programme)

☐ Final version before final term (contractual obligation)

Part 1 Overview and description of your project and its results

EC PROGRAMME :	**IST**
PROJECT TITLE & ACRONYM:	**Formal Design, Validation and Testing of Real-Time Telecommunications Systems – INTERVAL**
CONTRACT NUMBER :	**IST-1999-11557**
PROJECT WEB SITE (if any) :	http://www-interval.imag.fr
PARTNERS NAMES :	ITM UNIVERSITY LÜBECK (D) TELELOGIC (F) SOLINET (D) ERICSSON (S), FRANCE TELECOM R&D (F) TELETEL (EL), VERIMAG (F).

1.1 Executive summary

The aim of the project is to prototype a complete software engineering tool set for the development of systems with real time constraints. This tool set will build upon existing tools, based on SDL (for system description), MSC (for use cases) and TTCN (for testing), by adding the languages extensions and tool modules needed for dealing with real-time features of modern telecommunication systems.

The objectives of the project are the following:

- Real-Time extension of SDL (RT-SDL)
- Real-Time extension of MSC (RT-MSC)
- Real-Time extension of TTCN (RT-TTCN)
- Adaptation of existing tools to support RT-SDL, RT-MSC and RT-TTCN
- Modules for the analysis and validation of real-time requirements
- Automated test case generation based on the real-time requirements

The project will validate and disseminate the technology through:

- Evaluation of the approach by industrial end users in the Telecommunication domain
- Animation of an interest group including the major telecommunication players and the tool providers, in order to gather additional requirements and to exploit the results of the project
- Submission to standardisation bodies, in charge of SDL, MSC and TTCN at ITU-T and ETSI

The formal description techniques SDL (Specification and Description Language), MSC (Message Sequence Chart) and TTCN (Tree and Tabular Combined Notation) have proven to be very useful in particular in the Telecommunication industry. At the moment SDL and MSC are under revision in ITU-T study group 10 and the SDL 2000 and MSC 2000 have just emerged. This is part of the normal evolution of SDL and MSC, which have had a revision every 4 years (ITU study period).
Real-time aspects have not been included during the current study period, because there is little industrial experience in the application of real-time concepts in the context of formal description techniques. Therefore, there is little agreement on how the real-time extensions of SDL and MSC should look like. It is expected that the INTERVAL project will contribute its results to the current ITU-T study period so that they can be incorporated in the next revision of the language.

As far as TTCN is concerned, there is a similar situation. TTCN has just been revised and a third edition is available by ETSI. This third edition consists of two parts: a simple and flexible core notation and on top of it the TTCN presentation format. The INTERVAL project bases its work on the core notation that will be available in time for the start of the project.
There exist already highly professional and efficient tool environments for SDL, MSC and TTCN, which integrate all aspects of specification, design, validation, implementation and testing. Most of the major telecommunication equipment manufacturers and network operators use these environments in their system development processes

Modern telecommunication systems, such as mobile phone systems, belong to the class of distributed real-time systems. The real-time aspects of these systems become increasingly important, because of the communication of multimedia contents, which put tough requirements on their performance. Telecommunication systems have functional requirements (e.g. provided service) and non-functional requirements (e.g. performances, response time). Functional aspects of the system can only be fully validated and tested if the non-functional, especially timed aspects are satisfied. Current formal techniques for the design of such systems, e.g. SDL and TTCN, cover only parts of timed aspects. Furthermore, they often require two separate descriptions of the functional and timed aspects, which can only be validated separately.

An efficient approach for the development of such systems should fulfil the following requirements:

- The ability to specify timed requirements, both qualitative and quantitative, in early design phases.
- The integration of functional analysis and validation, based on a single/annotated model of the system ensuring a consistent development process.
- The generation of timed test suites derived from the specification model, and their execution on the implementation.

However, so far the applicability of the tools is constrained by the missing real-time functionality. It is the aim of the INTERVAL project to fill this gap in order to provide a consistent tool chain all the way from the requirement phase down to the testing phase including performance aspects. The integration of SDL, MSC and TTCN in the tool environments facilitated the automated test case generation. While test case generation based on SDL is well explored in the context of functional requirements, there are a number of unresolved issues in the context of non-functional requirements, such as real-time requirements.
The INTERVAL project is user driven, i.e. major actors in the telecommunications domain and the tool providers play the main roles in defining the requirements for the extensions of SDL, MSC and TTCN. One major telecom equipment manufacturer and one major telecom network operator are partners in the consortium, while other companies have been asked to participate in an Interest Group. This group will meet every six months during the project life time in order to collect user requirements and discuss the results of the project.

The expected results of the project are:

- Specification of timed extensions for SDL
- Specification of timed extensions for MSC
- Specification of timed extensions for TTCN
- Contribution to ETSI for timed extension to TTCN-3
- Contribution to ITU for timed extension to SDL 2000 and MSC 2000
- Prototype tools supporting timed extension for SDL & MSC
- Prototype tools supporting timed extension for TTCN
- Prototype toolset supporting timed SDL – TTCN co-simulation

1.2 Overview of all your main project results

No.	Self-descriptive title of the result	Category *	Partner(s) owning the result(s) (referring in particular to specific patents, copyrights, etc.) & involved in their further use
1	Specification of timed extensions for SDL	A	VERIMAG, TELELOGIC
2	Specification of timed extensions for MSC	A	ITM
3	Specification of timed extensions for TTCN	A	ITM
4	Contribution to ETSI for timed extensions to TTCN-3	A	ITM, ERICSSON
5	Contribution to ITU for timed extension to SDL 2000 and MSC 2000	A	VERIMAG, FRANCE TELECOM, ITM, TELELOGIC
6	Prototype tools supporting timed extension for SDL & MSC	A	TELELOGIC
7	Prototype tools supporting timed extensions for TTCN	A	SOLINET
8	Prototype toolset supporting timed SDL – TTCN co-simulation	A	TELELOGIC, SOLINET

* A: results usable outside the consortium / B: results usable within the consortium / C: non usable results

1.3 Quantified Data on the dissemination and use of the project results

Items about the dissemination and use of the project results (consolidated numbers)	Currently achieved quantity	Estimated future* quantity
# of product innovations (commercial)	.....	.....
# of process innovations (commercial)	.....	.....
# of new services (commercial)	.....	.....
# of new services (public)	.....	.....
# of new methods (academic)	.....	.....2.....
# of scientific breakthrough	.....	.....1.....
# of technical standards to which this project has contributed	.....	.....3.....
# of EU regulations/directives to which this project has contributed	.....	.....
# of international regulations to which this project has contributed	.....	.....
# of PhDs generated by the project	.....….....	.....4.....
# of grantees/trainees including transnational exchange of personnel	.....	.....

*# = number of ... / * "Future" means expectations within the next 3 years following the end of the project*

1.4 **Description of each single result** *(one form per result)*

1.4.1 Specification of timed extensions for SDL

SUMMARY *(200 words maximum)*

There is no difference between SDL96 and SDL2000 with respect to their ability to specify and validate real-time designs. We have identified the missing features: these are on one hand missing programming features, such as emergency timeouts, but essentially absence of the possibility to make the right assumptions on the possible time progress for validation. The impossibility to distinguish (time related) programming features and assumptions on the environment leads to difficulties in the verification process. We have already made some propositions allowing to improve the expressiveness of SDL in this respect and some of them are being used in the case studies.

Please categorise the result using codes from Annex 1

Subject descriptor codes	120	609	598	611

CURRENT STAGE OF DEVELOPMENT

Please tick one category only ✓

Scientific and/or Technical knowledge (Basic research)	☒
Guidelines, methodologies, technical drawings	☒
Software code	☐
Experimental development stage (laboratory prototype)	☐
Prototype/demonstrator available for testing	☐
Results of demonstration trials available	☐
Other (please specify.):	☐

DOCUMENTATION AND INFORMATION ON THE RESULT

List main information and documentation, stating whether public or confidential.

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: *PU*=Public *CO*=Confidential**
Report	Deliverable D1.1 "Requirements analysis and specification" 10/2000	PU
Report	Deliverable D1.3 v1 "Preliminary specification of timed extensions" 11/2000	PU
Report	Workshop submission "SDL for real time: what is missing?"	PU

INTELLECTUAL PROPERTY RIGHTS

Indicate all generated knowledge and possible pre-existing know-how (background or sideground) being exploited

Type of IPR	**Tick a box and give the corresponding details (reference numbers, etc.) if appropriate.**		**Knowledge *(K)*/ Pre-existing know-how *(P)***
	Current	**Foreseen**	
Patent applied for	☐……..	☐	
Patent search carried out	☐ ……..	☐	
Patent granted	☐……..	☐	
Registered design	☐ ……..	☐	
Trademark applications	☐ ……..	☐	
Copyrights	☐ ……..	☐	
Secret know-how	☐	☐	
other – please specify :	☐ ……..	☐	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 2.

Market application sectors	64	32	34	35

1.4.2 Specification of timed extensions for MSC

SUMMARY *(200 words maximum)*

A first assessment of MSC 2000 showed that the newest version of this trace language is already nearly suitable for real-time issues. Just a few concepts like periodic behavior are missing. These missing concepts are added in the INTERVAL project resulting in a proposal extending the ITU-T Z.120 norm. Potential applications of these extensions are everywhere, where requirements capture, modeling, tracing or testing of message-based communicating systems are involved. For the end user, this enables a more powerful usage of formal methods for real-time communication systems, improving the reliability and the quality of products.

Please categorise the result using codes from Annex 1

Subject descriptor codes	120	609	598	611

CURRENT STAGE OF DEVELOPMENT

Please tick one category only ✓

Scientific and/or Technical knowledge (Basic research)	☒
Guidelines, methodologies, technical drawings	☐
Software code	☐
Experimental development stage (laboratory prototype)	☐
Prototype/demonstrator available for testing	☐
Results of demonstration trials available	☐
Other (please specify.):	☐

DOCUMENTATION AND INFORMATION ON THE RESULT

List main information and documentation, stating whether public or confidential.

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: *PU*=Public *CO*=Confidential**
Report	Deliverable D1.1 "Requirements analysis and specification" 10/2000	PU
Report	Deliverable D1.3 v1 "Preliminary specification of timed extensions" 11/2000	PU

INTELLECTUAL PROPERTY RIGHTS

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Type of IPR	**Tick a box and give the corresponding details (reference numbers, etc.) if appropriate.**		**Knowledge *(K)*/ Pre-existing know-how *(P)***
	Current	**Foreseen**	
Patent applied for	☐……..	☐	
Patent search carried out	☐ ……..	☐	
Patent granted	☐……..	☐	
Registered design	☐ ……..	☐	
Trademark applications	☐ ……..	☐	
Copyrights	☐ ……..	☐	
Secret know-how	☐	☐	
other – please specify :	☐ ……..	☐	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 2.

Market application sectors	64	32	34	35

1.4.3 Specification of timed extensions for TTCN

SUMMARY *(200 words maximum)*

TTCN-3 will be extended in order to allow for real-time testing. Concepts for making real-time tests deterministic and a standardized way to describe real-time requirements have to be added.
These missing concepts are added in the INTERVAL project resulting in a proposal extending the ETSI norm DES/MTS-00063-1. Potential applications of these extension are everywhere, where real-time testing of message or API (application program interface) based communicating systems is involved. For the end user, this enables a more powerful usage of formal methods for real-time communication systems testing, improving the reliability and the quality of products.

Please categorise the result using codes from Annex 1

Subject descriptor codes	120	609	611	

CURRENT STAGE OF DEVELOPMENT

Please tick one category only ✓

Scientific and/or Technical knowledge (Basic research)	☒
Guidelines, methodologies, technical drawings	☐
Software code	☐
Experimental development stage (laboratory prototype)	☐
Prototype/demonstrator available for testing	☐
Results of demonstration trials available	☐
Other (please specify.):	☐

DOCUMENTATION AND INFORMATION ON THE RESULT

List main information and documentation, stating whether public or confidential.

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: *PU*=Public *CO*=Confidential**
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Type of IPR	**Tick a box and give the corresponding details (reference numbers, etc.) if appropriate.**		**Knowledge *(K)*/ Pre-existing know-how *(P)***
	Current	**Foreseen**	
Patent applied for	☐……..	☐	
Patent search carried out	☐ ……..	☐	
Patent granted	☐……..	☐	
Registered design	☐ ……..	☐	
Trademark applications	☐ ……..	☐	
Copyrights	☐ ……..	☐	
Secret know-how	☐	☐	
other – please specify :	☐ ……..	☐	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 2.

Market application sectors	64	32	34	35

1.4.4 Contribution to ETSI for timed extensions to TTCN-3

SUMMARY *(200 words maximum)*

The extensions to TTCN-3 which are specified during the INTERVAL project will be submitted to the European Telecommunications Standards Institute (ETSI) as extension to the current TTCN-3 norm DES/MTS-00063-1. Since changes to this norm are regularly submitted to ITU-T Study Group 10, the changes submitted to ETSI will also be submitted for ITU-T Recommendation Z.140

Please categorise the result using codes from Annex 1

Subject descriptor codes	120	609	611	

CURRENT STAGE OF DEVELOPMENT

Please tick one category only ✓

Scientific and/or Technical knowledge (Basic research)	☒
Guidelines, methodologies, technical drawings	☐
Software code	☐
Experimental development stage (laboratory prototype)	☐
Prototype/demonstrator available for testing	☐
Results of demonstration trials available	☐
Other (please specify.):	☐

DOCUMENTATION AND INFORMATION ON THE RESULT

List main information and documentation, stating whether public or confidential.

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: *PU*=Public *CO*=Confidential**
Report	Deliverable D1.3 v1 "Preliminary specification of timed extensions" 11/2000	PU

INTELLECTUAL PROPERTY RIGHTS

Indicate all generated knowledge and possible pre-existing know-how (background or sideground) being exploited

Type of IPR	**Tick a box and give the corresponding details (reference numbers, etc.) if appropriate.**		**Knowledge *(K)*/ Pre-existing know-how *(P)***
	Current	**Foreseen**	
Patent applied for	☐……..	☐	
Patent search carried out	☐ ……..	☐	
Patent granted	☐……..	☐	
Registered design	☐ ……..	☐	
Trademark applications	☐ ……..	☐	
Copyrights	☐ ……..	☐	
Secret know-how	☐	☐	
other – please specify :	☐ ……..	☐	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 2.

Market application sectors	64	32	34	35

1.4.5 Contribution to ITU for timed extension to SDL 2000 and MSC 2000

SUMMARY *(200 words maximum)*

The extensions to MSC 2000 which are specified during the INTERVAL project will be submitted to the International Telecommunication Unit (ITU) as extension to the Z.120 norm. This norm is currently maintained in the Study Group 10 of ITU-T, Question 7 and Question 9.

The extensions to SDL which have been and will be specified during the INTERVAL project will be submitted to the International Telecommunication Union (ITU) partly as extension of the norm Z.100 and partly as norm Z.108 which is being studied under the leadership of INTERVAL in the Question 7 of Study Group 10.

Please categorise the result using codes from Annex 1

Subject descriptor codes	120	609	598	611

CURRENT STAGE OF DEVELOPMENT

Please tick one category only ✓

Scientific and/or Technical knowledge (Basic research)	☒
Guidelines, methodologies, technical drawings	☐
Software code	☐
Experimental development stage (laboratory prototype)	☐
Prototype/demonstrator available for testing	☐
Results of demonstration trials available	☐
Other (please specify.):	☐

DOCUMENTATION AND INFORMATION ON THE RESULT

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Documentation type	**Details (Title, ref. number, general description, language)**	**Status: *PU*=Public *CO*=Confidential**
Report	Deliverable D1.3 v1 "Preliminary specification of timed extensions" 11/2000	PU

INTELLECTUAL PROPERTY RIGHTS

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Type of IPR	**Tick a box and give the corresponding details (reference numbers, etc.) if appropriate.**		**Knowledge *(K)*/ Pre-existing know-how *(P)***
	Current	**Foreseen**	
Patent applied for	☐……..	☐	
Patent search carried out	☐ ……..	☐	
Patent granted	☐……..	☐	
Registered design	☐ ……..	☐	
Trademark applications	☐ ……..	☐	
Copyrights	☐ ……..	☐	
Secret know-how	☐	☐	
other – please specify :	☐ ……..	☐	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 2.

Market application sectors	64	32	34	35

1.4.6 Prototype tools supporting timed extensions for SDL & MSC

SUMMARY *(200 words maximum)*

The prototyping of timed extensions for SDL & MSC will be first realized in the existing ObjectGEODE toolset, and will then be consolidated in the Next Generation toolset to be released by TELELOGIC by the end of the project. At the editing level, the timed information will be supported through annotations to SDL and MSC. At the simulation level, the timed annotations will be translated into an internal property language that will be executed by the simulator. The prototype will show the feasibility of the real-time extensions that are defined in the INTERVAL project and that are submitted for standardization to the ITU-T group SG10 in charge of SDL and MSC. The developed prototype will be applied on the models studied in WP3 for the validation of real-time protocols with realistic timing constraints.

Please categorise the result using codes from Annex 1

Subject descriptor codes	120	609	600	565

CURRENT STAGE OF DEVELOPMENT

Please tick one category only ✓

Scientific and/or Technical knowledge (Basic research)	☒
Guidelines, methodologies, technical drawings	☒
Software code	☐
Experimental development stage (laboratory prototype)	☐
Prototype/demonstrator available for testing	☐
Results of demonstration trials available	☐
Other (please specify.):	☐

DOCUMENTATION AND INFORMATION ON THE RESULT

List main information and documentation, stating whether public or confidential.

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: *PU*=Public *CO*=Confidential**
Report	Deliverable D1.1 "Requirements analysis and specification" 10/2000	PU
Report	Deliverable D1.2 "Specification of the supporting toolset" 12/2000	PU
Report	Deliverable D1.3 v1 "Preliminary specification of timed extensions" 11/2000	PU

INTELLECTUAL PROPERTY RIGHTS

Indicate all generated knowledge and possible pre-existing know-how (background or sideground) being exploited

Type of IPR	**Tick a box and give the corresponding details (reference numbers, etc.) if appropriate.**		**Knowledge *(K)*/ Pre-existing know-how *(P)***
	Current	**Foreseen**	
Patent applied for	☐……..	☐	
Patent search carried out	☐ ……..	☐	
Patent granted	☐……..	☐	
Registered design	☐ ……..	☐	
Trademark applications	☐ ……..	☐	
Copyrights	☐ ……..	☐	
Secret know-how	☐	☐	
other – please specify :	☐ ……..	☐	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 2.

Market application sectors	64	72		

1.4.7 Prototype tools supporting timed extensions for TTCN

SUMMARY *(200 words maximum)*

The TTCN prototype tool that will be developed within the INTERVAL project will be used to validate the proposed timed extensions to TTCN. It will support the real time extensions for the TTCN language that are described in aforementioned relevant INTERVAL project result. The timed extension will be mapped to TTCN-2, but they can be easily transferred to a tool supporting TTCN-3 whenever this is available. It will be suitable for testing telecommunication protocols, which their behavior comprise time critical characteristics. The TTCN prototype tool will be based on the existing CONTESSA toolset, which is provided by SOLINET.

Please categorise the result using codes from Annex 1

Subject descriptor codes	120	609	611	

CURRENT STAGE OF DEVELOPMENT

Please tick one category only ✓

Scientific and/or Technical knowledge (Basic research)	☐
Guidelines, methodologies, technical drawings	☒
Software code	☐
Experimental development stage (laboratory prototype)	☐
Prototype/demonstrator available for testing	☐
Results of demonstration trials available	☐
Other (please specify.):	☐

DOCUMENTATION AND INFORMATION ON THE RESULT

List main information and documentation, stating whether public or confidential.

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: *PU*=Public *CO*=Confidential**
Report	Deliverable D1.1 "Requirements analysis and specification" 10/2000	PU
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INTELLECTUAL PROPERTY RIGHTS

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Type of IPR	**Tick a box and give the corresponding details (reference numbers, etc.) if appropriate.**		**Knowledge *(K)*/ Pre-existing know-how *(P)***
	Current	**Foreseen**	
Patent applied for	☐……..	☐	
Patent search carried out	☐ ……..	☐	
Patent granted	☐……..	☐	
Registered design	☐ ……..	☐	
Trademark applications	☐ ……..	☐	
Copyrights	☐ ……..	☐	
Secret know-how	☐	☐	
other – please specify :	☐ ……..	☐	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 2.

Market application sectors	64			

1.4.8 Prototype toolset supporting timed SDL – TTCN cosimulation

SUMMARY *(200 words maximum)*

The timed SDL-TTCN co-simulation prototype will allow to match an SDL description of a system with a given TTCN test suite of the same system. Either the SDL description is the reference (validated through extensive simulation) then co-simulation allows to test the validity of the TTCN test suite. If the test suite is the reference (e.g. provided by ETSI), the co-simulation is meant for first testing of the SDL description before code generation. The objective is to verify whether the provided SDL model complies with the time constraints imposed by the timed TTCN test suite. Another objective of co-simulation can be to complete TTCN test suites by generating automatically the values of parameters in the test suite. The SDL-TTCN co-simulation will be controlled by the TTCN tool, since the TTCN represents the environment which drives the SDL system. The prototype will then be realized by extending the CONTESSA Campaigner for TTCN which is provided by SOLINET, and connecting it to the communication protocol used by the SDL simulator from TELELOGIC.

Please categorise the result using codes from Annex 1

Subject descriptor codes	120	609	611	565

CURRENT STAGE OF DEVELOPMENT

Please tick one category only ✓

Scientific and/or Technical knowledge (Basic research)	☒
Guidelines, methodologies, technical drawings	☒
Software code	☐
Experimental development stage (laboratory prototype)	☐
Prototype/demonstrator available for testing	☐
Results of demonstration trials available	☐
Other (please specify.):	☐

DOCUMENTATION AND INFORMATION ON THE RESULT

List main information and documentation, stating whether public or confidential.

Documentation type	**Details (Title, ref. number, general description, language)**	**Status: *PU*=Public *CO*=Confidential**
Report	Deliverable D1.1 "Requirements analysis and specification" 10/2000	PU
Report	Deliverable D1.2 "Specification of the supporting toolset" 12/2000	PU
Report	Deliverable D1.3 v1 "Preliminary specification of timed extensions" 11/2000	PU

1.4.8.1.1.1.1.1.1 INTELLECTUAL PROPERTY RIGHTS

Indicate all generated knowledge and possible pre-existing know-how (background or sideground) being exploited

Type of IPR	**Tick a box and give the corresponding details (reference numbers, etc.) if appropriate.**		**Knowledge *(K)*/ Pre-existing know-how *(P)***
	Current	**Foreseen**	
Patent applied for	☐……..	☐	
Patent search carried out	☐ ……..	☐	
Patent granted	☐……..	☐	
Registered design	☐ ……..	☐	
Trademark applications	☐ ……..	☐	
Copyrights	☐ ……..	☐	
Secret know-how	☐	☐	
other – please specify :	☐ ……..	☐	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 2.

Market application sectors	64	72		

1.5 Quantified data about the result (one form per result)

Items (about the results)	**Actual current quantity [a]**	**Estimated (or future) quantity [b]**
Time to application / market (in months from the end of the research project)		
Number of (public or private) entities potentially involved in the implementation of the result :		
of which : number of SMEs :		
of which : number of entities in third countries (outside EU) .		
Targeted user audience: # of reachable people		
# of S&T publications (referenced publications only)		
# of publications addressing general public (e.g. CD-ROMs, WEB sites)		
# of publications addressing decision takers / public authorities / etc.		
Visibility for the general public	Yes / No	

[a] *Actual current quantity = the number of items already achieved to date.*
[b] *Estimated quantity = estimation of the quantity of the corresponding item or the number of items that you foresee to achieve within the next 3 years.*

I, **project co-ordinator**, confirm the publishable information contained in this part 1 (sections 1.1 to 1.5) of the Technological Implementation Plan.

Signature: **Name:**

Date: **Organisation:**

Part 2 Description of the intentions by each partner

This part 2 must be completed by each partner who is essential for the dissemination and use (i.e. result owners and/or major project contributors and/or major dissemination and use contributors). Each will detail its own use and dissemination intentions concerning the result(s) they are involved with. This description must be made result by result.

These different parts may be transmitted to the Commission either assembled at the consortium level, or individually by each partner to safeguard confidential matters if necessary (through any appropriate media). Obviously, when all partners are implementing a single dissemination and use scheme all together, a single part 2 is needed.

PARTS 2 WILL ALWAYS BE KEPT CONFIDENTIAL BY THE COMMISSION

2.1 Description of the use and the dissemination of result(s), partner per partner

MANDATORY INFORMATION :

CONTRACT NUMBER :	**IST-1999-11557**
PARTNER's NAME :	**SOLINET GmbH**
PARTNER's WEB SITE (if any) :	http://www.solinet.com

CONTACT PERSON(S):

Name	Stefan Haaf
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No, TITLE *(as in section 1.2)* **AND BRIEF DESCRIPTION OF MAIN RESULT(S)**

7	**Prototype tool supporting timed extensions for TTCN**. The TTCN prototype tool that will be developed within the INTERVAL project will be used to validate the proposed timed extensions to TTCN. It will support the real time extensions for the TTCN language that are described in aforementioned relevant INTERVAL project result.

FOR EACH MAIN RESULT, TIMETABLE OF THE USE AND DISSEMINATION ACTIVITIES WITHIN THE NEXT 3 YEARS AFTER THE END OF THE PROJECT

Mention the use and dissemination related activities, the main associated partners, the related milestones and give an indicative timescale		
Activity	**Brief description of the activity, including main milestones and deliverables (and how it relates to data in sections 1.5 and 2.2).**	**Timescale (months)**
Standardization (ETSI)	**Proof of timing concepts introduced through prototyping**	**> 12 months**

FORESEEN COLLABORATIONS WITH OTHER ENTITIES

Please tick appropriate boxes (✓) corresponding to your most probable follow-up.

R&D	Further research or development	☒	**FIN**	Financial support	☐
LIC	Licence agreement	☐	**VC**	Venture capital/spin-off funding	☐
MAN	Manufacturing agreement	☐	**PPP**	Private-public partnership	☐
MKT	Marketing	☐	**INFO**	Information exchange, training	☐
JV	Joint venture	☐	**CONS**	Available for consultancy	☐
			Other	(please specify)	☐

CONTRACT NUMBER :	**IST-1999-11557**
PARTNER's NAME :	**ITM LUEBECK**
PARTNER's WEB SITE (if any) :	http://www.itm.mu-luebeck.de

CONTACT PERSON(S):

Name	Dieter Hogrefe
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No, TITLE *(as in section 1.2)* **AND BRIEF DESCRIPTION OF MAIN RESULT(S)**

2	Specification of timed extensions for MSC: Missing concepts for real-time are identified and added to MSC2000 standard
3	Specification of timed extensions for TTCN: Missing concepts for real-time are identified and added to TTCN-3 standard
4	Contribution to ETSI for timed extensions to TTCN-3: extensions to TTCN-3 are standardized
5	Contribution to ITU-T for timed extension to SDL 2000 and MSC 2000: extensions to SDL 2000 and MSC 2000 are standardized

FOR EACH MAIN RESULT, TIMETABLE OF THE USE AND DISSEMINATION ACTIVITIES WITHIN THE NEXT 3 YEARS AFTER THE END OF THE PROJECT

Mention the use and dissemination related activities, the main associated partners, the related milestones and give an indicative timescale		
Activity	**Brief description of the activity, including main milestones and deliverables (and how it relates to data in sections 1.5 and 2.2).**	**Timescale (months)**
Standardization	**European and world-wide dissemination of the timed extensions is aimed by submitting them to ETSI and ITU-T.**	**> 12 months**

FORESEEN COLLABORATIONS WITH OTHER ENTITIES

Please tick appropriate boxes (✓) corresponding to your most probable follow-up.

R&D	Further research or development	☒	**FIN**	Financial support	☐
LIC	Licence agreement	☐	**VC**	Venture capital/spin-off funding	☐
MAN	Manufacturing agreement	☐	**PPP**	Private-public partnership	☐
MKT	Marketing	☐	**INFO**	Information exchange, training	☐
JV	Joint venture	☐	**CONS**	Available for consultancy	☐
			Other	(please specify)	☐

CONTRACT NUMBER :	IST-11557
PARTNER's NAME :	**ERICSSON**
PARTNER's WEB SITE (if any) :	http://www.ericsson.se

CONTACT PERSON(S):

Name	Stefan Strömqvist
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No, TITLE *(as in section 1.2)* **AND BRIEF DESCRIPTION OF MAIN RESULT(S)**

2 3	Specification of timed extensions for MSC Specification of timed extensions for TTCN This result will allow Ericsson to investigate and influence the proposals made within INTERVAL for real time extensions to the aforementioned languages. In particular, the specific real time needs of telecom systems were identified and used to influence the proposed language extensions both from the perspective of modelling and design of telecom services, as well as from the subsequent testing of those services.
6 7 8	Prototype tools supporting timed extensions for SDL & MSC Prototype tools supporting timed extensions for TTCN Prototype toolset supporting timed SDL – TTCN co-simulation This result will enable Ericsson to make a thorough investigation of both the time extensions to the aforementioned languages as well as the tool support associated with them.

FOR EACH MAIN RESULT, TIMETABLE OF THE USE AND DISSEMINATION ACTIVITIES WITHIN THE NEXT 3 YEARS AFTER THE END OF THE PROJECT

Mention the use and dissemination related activities, the main associated partners, the related milestones and give an indicative timescale		
Activity	**Brief description of the activity, including main milestones and deliverables (and how it relates to data in sections 1.5 and 2.2).**	**Timescale (months)**
1 - 2	**Ericsson intends to use the results from INTERVAL in various ways.** **Firstly, Ericsson intends to use the results to aid in their development process, e.g. to apply the real-time tools developed within INTERVAL for the creation of next generation services where real time aspects are of specific importance.** **Secondly, Ericsson intends to use the results of INTERVAL to train and guide their existing staff and associated partners in aspects related to real time systems. This includes, training related to how real time systems can best be modeled and designed, through to how those systems can be tested most efficiently.**	**On-going with no deadline for completion**

FORESEEN COLLABORATIONS WITH OTHER ENTITIES

Please tick appropriate boxes (✓) corresponding to your most probable follow-up.

R&D	Further research or development	✓	**FIN**	Financial support	☐
LIC	Licence agreement	☐	**VC**	Venture capital/spin-off funding	☐
MAN	Manufacturing agreement	☐	**PPP**	Private-public partnership	☐
MKT	Marketing	☐	**INFO**	Information exchange, training	✓
JV	Joint venture	☐	**CONS**	Available for consultancy	✓
			Other	(please specify)	☐

MANDATORY INFORMATION :

CONTRACT NUMBER :	**IST-1999-11557**
PARTNER's NAME :	**TELELOGIC Technologies Toulouse**
PARTNER's WEB SITE (if any) :	http://www.telelogic.com

CONTACT PERSON(S):

Name	Alain Kerbrat
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No, TITLE *(as in section 1.2)* **AND BRIEF DESCRIPTION OF MAIN RESULT(S)**

6	**Prototype tools supporting timed extensions for SDL & MSC**. These prototype tools that will be developed within the INTERVAL project will be used to validate the proposed timed extensions to SDL and MSC. They will support the real time extensions for the SDL and MSC languages that result from the INTERVAL project. In addition timed test generation from timed SDL & MSC models will be explored and assessed with the active involvement of ITM LÜBECK.

FOR EACH MAIN RESULT, TIMETABLE OF THE USE AND DISSEMINATION ACTIVITIES WITHIN THE NEXT 3 YEARS AFTER THE END OF THE PROJECT

Mention the use and dissemination related activities, the main associated partners, the related milestones and give an indicative timescale		
Activity	**Brief description of the activity, including main milestones and deliverables (and how it relates to data in sections 1.5 and 2.2).**	**Timescale (months)**
Demonstration to prospects	**Visit of potential prospects having to deal with timed constraints in the systems they develop (telecom, automotive industries). Benefits of formal approach and powerful simulation/verification capabilities for real-time applications**	**> 12 months**
Standardization (ITU-T)	**Proof of timing concepts introduced through prototyping**	**> 12 months**

FORESEEN COLLABORATIONS WITH OTHER ENTITIES

Please tick appropriate boxes (✓) corresponding to your most probable follow-up.

R&D	Further research or development	☒	**FIN**	Financial support	☐
LIC	Licence agreement	☐	**VC**	Venture capital/spin-off funding	☐
MAN	Manufacturing agreement	☐	**PPP**	Private-public partnership	☐
MKT	Marketing	☐	**INFO**	Information exchange, training	☐
JV	Joint venture	☐	**CONS**	Available for consultancy	☐
			Other	(please specify)	☐

MANDATORY INFORMATION :

CONTRACT NUMBER :	**IST-1999-11557**
PARTNER's NAME :	**TELETEL**
PARTNER's WEB SITE (if any) :	http://www.teletel.gr

CONTACT PERSON(S):

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No, TITLE *(as in section 1.2)* **AND BRIEF DESCRIPTION OF MAIN RESULT(S)**

2 3	Specification of timed extensions for MSC Specification of timed extensions for TTCN
6 7 8	Prototype tools supporting timed extension for SDL & MSC Prototype tools supporting timed extension for TTCN Prototype toolset supporting timed SDL – TTCN co-simulation

FOR EACH MAIN RESULT, TIMETABLE OF THE USE AND DISSEMINATION ACTIVITIES WITHIN THE NEXT 3 YEARS AFTER THE END OF THE PROJECT

Mention the use and dissemination related activities, the main associated partners, the related milestones and give an indicative timescale		
Activity	**Brief description of the activity, including main milestones and deliverables (and how it relates to data in sections 1.5 and 2.2).**	**Timescale (months)**
Company Internal Exploitation	**Internal use of the results, getting experience with real-time extensions, dissemination of the results to all company departments**	**> 8 months**

FORESEEN COLLABORATIONS WITH OTHER ENTITIES

Please tick appropriate boxes (✓) corresponding to your most probable follow-up.

R&D	Further research or development	☒	**FIN**	Financial support	☐
LIC	Licence agreement	☐	**VC**	Venture capital/spin-off funding	☐
MAN	Manufacturing agreement	☐	**PPP**	Private-public partnership	☐
MKT	Marketing	☐	**INFO**	Information exchange, training	☒
JV	Joint venture	☐	**CONS**	Available for consultancy	☐
			Other	(please specify)	☐

MANDATORY INFORMATION :

CONTRACT NUMBER :	**IST-1999-11557**
PARTNER's NAME :	**FRANCE TELECOM R&D**
PARTNER's WEB SITE (if any) :	http://www.rd.francetelecom.fr

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E-mail	Daniel.Vincent@rd.francetelecom.fr

No, TITLE *(as in section 1.2)* **AND BRIEF DESCRIPTION OF MAIN RESULT(S)**

1-5	**Specification of timed extensions for SDL and Contribution to ITU** FRANCE TELECOM R&D participates actively in the standardization of the SDL language in ITU-T/SG10. The results coming from the INTERVAL project will be submitted to ITU-T. These results will be obtained through a close collaboration with VERIMAG, and subject to a thorough validation on a real example (RMTP-II : a reliable multicast protocol over IP).

FOR EACH MAIN RESULT, TIMETABLE OF THE USE AND DISSEMINATION ACTIVITIES WITHIN THE NEXT 3 YEARS AFTER THE END OF THE PROJECT

Mention the use and dissemination related activities, the main associated partners, the related milestones and give an indicative timescale		
Activity	**Brief description of the activity, including main milestones and deliverables (and how it relates to data in sections 1.5 and 2.2).**	**Timescale (months)**
Specification of timed extensions for SDL	**Work together with VERIMAG in order to select the good extensions for the language for :** • **Validation of the model** • **Test generation** • **Code generation**	**> 12 months**
Standardization (ITU-T)	**Active participation to ITU-T/SG10/Q7 responsible for a new recommendation on time and performance for SDL** **(Daniel Vincent (FT) is rapporteur of this question, while Suzanne Graf (VERIMAG) is appointed editor of the new recommendation)**	**> 18 months**
Validation by experiment	**FT R&D will achieve a complete validation of the new proposed extensions by implementing a protocol model with the prototype tools IF (VERIMAG) and ObjectGEODE (TELELOGIC)**	**> 18 months**

FORESEEN COLLABORATIONS WITH OTHER ENTITIES

Please tick appropriate boxes (✓) corresponding to your most probable follow-up.

R&D	Further research or development	☒	**FIN**	Financial support	☐
LIC	Licence agreement	☐	**VC**	Venture capital/spin-off funding	☐
MAN	Manufacturing agreement	☐	**PPP**	Private-public partnership	☐
MKT	Marketing	☐	**INFO**	Information exchange, training	☐
JV	Joint venture	☐	**CONS**	Available for consultancy	☐
			Other	(please specify)	☐

2.2 Quantified data for each partner's main result

Items	Currently achieved quantity [a]	Estimated future quantity [b]
Economic impacts (in EURO)	.....	.....
# of licenses issued (within EU)	.....	.....
# of licenses issued (outside EU)	.....	.....
Total value of licenses (in EURO)	.....	.....
# of entrepreneurial actions (start-up company, joint ventures…)	.....	.....
# of direct jobs created [c]	.....	.....
# of direct jobs safeguarded [c]	.....	.....
# of direct jobs lost	.....	.....

[a] *The added value or the number of items already achieved to date.*
[b] *Estimated quantity = estimation of the quantity of the corresponding item or the number of items that you foresee to achieve in the future (i.e. expectations within the next 3 years following the end of the project).*
[c] *"Direct jobs" means jobs within the partner involved. Research posts are to be excluded from the jobs calculation*
 # = number of ...

I confirm the information contained in part 2 of this Technological Implementation Plan and I certify that these are our exploitation intentions

Signature: **Name:**

Date:

Part 3 Search for Collaboration through Commission services (Optional)

A separate part 3 might be completed by each partner willing to set up new collaborations, and seeking dissemination support from the CORDIS services.

The part 3 must be consolidated at the consortium level and transmitted to the Commission by the co-ordinator.

PARTS 3 WILL BE DISSEMINATED BY THE COMMISSION

CONTACT PERSON FOR THIS EXPLOITABLE RESULT

Name	
Position	
Organisation	
Address	
Telephone	
Fax	
E-mail	

Collaborations SOUGHT

Please tick appropriate boxes (✓) corresponding to your needs.

R&D	Further research or development	☐	**FIN**	Financial support	☐
LIC	Licence agreement	☐	**VC**	Venture capital/spin-off funding	☐
MAN	Manufacturing agreement	☐	**PPP**	Private-public partnership	☐
MKT	Marketing	☐	**INFO**	Information exchange	☐
JV	Joint venture	☐	**CONS**	Available for consultancy	☐
			Other	(please specify)	☐

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

Please, clearly describe your input, the value and interest of the applications and the dissemination and use opportunities that you can offer to your potential partner.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Please, clearly describe the profile and the expected input from the external partner(s).

I confirm the information contained in part 3 of this Technological Implementation Plan and I authorise its dissemination to assist this search for collaboration.

Signature: **Name:**

Date: **Organisation:**

Part 4 Comment on European Interest

4.1 Community added value and contribution to EU policies

4.1.1 European dimension of the problem

The project targets the telecommunication industry, which operates on an international scale. National operators need to co-operate, as demonstrated by the standardization efforts invested in language and development process for telecommunication software. The driving forces for the standardization of languages for Telecommunications (SDL, MSC and TTCN), as well as the tool vendors, are essentially European, giving to Europe a leading edge on these technologies.

This project will allow to keep this leading edge, by updating the standards and the corresponding tools to support the new directions in telecommunications. The extensions of these techniques to hard real time applications will help these suppliers to gain on efforts, time and quality, as they will be able to design, verify and test all aspects of their new systems in a single and coherent development environment. This will help to improve the competitiveness of European telecommunication suppliers, who are familiar with these techniques.

4.1.2 Contribution to developing S&T co-operation at international level. European added value

The acceptance and widespread use of the real-time extensions of SDL, MSC and TTCN developed in this project, can only be achieved if several major European actors are involved. This project is ensured of a good geographical coverage, with French, German, Greek and Swedish partners. It gathers the French national operator (FRANCE TELECOM R&D), a world-leading telecommunications supplier (ERICSSON) and a Greek telecommunications supplier (TELETEL). TELELOGIC and SOLINET are tool vendors with an international customer's base, and ITM-LÜBECK is an internationally recognized institute, both for its scientific works, and its involvement in standardization bodies. The alliance of these companies, which are diverse, yet led by a common set of goals, gives the project a high level of recognition.

One important output of the project is the standardization of the extensions brought to SDL, MSC and TTCN. Most of the participants to the project are involved in the standardization works: on the SDL side, TELELOGIC and FRANCE TELECOM R&D with the support of VERIMAG; on the TTCN side, ERICSSON, FRANCE TELECOM R&D, ITM-LÜBECK and SOLINET. The weight of a given consortium in a standardization body depends partly on the number of its representatives, but also on the variety of nations they represent.

4.1.3 Contribution to policy design or implementation

An important dissemination activity within the INTERVAL framework will be the transfer of language extensions and methodological approach to the standardization bodies. This transfer will be led by three partners: ITM-LÜBECK, ERICSSON and FRANCE TELECOM R&D; ERICSSON will co-ordinate the acceptance of the timed extensions to the languages among the Interest Group, ITM will concentrate on the MSC and TTCN notations at ITU-T and ETSI (TTCN-2: Norm ISO-9646-3, TTCN-3: Norm ITU-T Z.140, MSC: Norm Z.120), and FRANCE TELECOM R&D with VERIMAG will concentrate on the SDL notation at ITU-T (Norm Z.100). The other partners will support this transfer by their representatives at ITU-T and ETSI technical meetings.

A major objective of the project is to get our proposals accepted and integrated in those standards. This would ensure the maximum benefit for the industrial users and the other tool providers, because the results would become largely visible and available outside the project. The tool vendors participating in the project should also benefit from this exposition if the market acceptance by users is enhanced, thus leading to a much increased volume of sales. More generally, acceptance of the developed extensions to the formalisms as the standard will lead better tool support and a competitive advantage for the European user community.

4.2 Contribution to Community social objectives

The improvement of development methods and tools for real time systems, as provided by this project, bring benefits in the following areas:

4.2.1 Improving the quality of life in the Community

- *Efficient telecommunications*. With the development of communication facilities in many human related activities, the failure of a telecommunication switch or the loss of data can have dramatic impact on the safety of individuals. The growing volume of data transferred, and the increasing need for multimedia content, shifts the focus on temporal constraints, both for optimizing the performances, and to describe and guarantee a Quality of Service.
- *Safer critical systems*. The correct behavior of many critical systems (planes on-board computers, power-plant control, computer controlled medical equipment,..) depend on temporal constraints. A classical example is the Therac 25 incident, where a radiation therapy machine could deliver overdoses when a given sequence of commands was typed very quickly. The ability to design and validate these systems with respect to these time aspects in early phases of the development process, will help to develop these systems within the same budget, but with a higher level of quality, thus a higher level of safety.

4.2.2 Provision of appropriate incentives for monitoring and creating jobs in the Community)

- *Better employment*. This project works on topics where Europe has a leading edge in an overall very competitive area. As in any competition in market shares, a bonus goes to the leader, so keeping this lead is crucial in terms of market, thus employment.

4.2.3 Supporting sustainable development, preserving and/or enhancing the environment

- *Higher product quality*. The technology developed in the INTERVAL project will significantly improve the quality of the systems thanks to an integrated development process supported by efficient modeling and validation tools. These tools operate at a higher abstraction level which favors components reuse, formalize the requirements and the specifications thus avoiding ambiguities, and automate several generation tasks e.g. code and tests, thus reducing the number of design errors. As a result, the cost of the errors is reduced, they are detected very early, and the final product is released much quicker.